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Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

PYROMETRIC CONE EQUIVALENTS OF THREE SAMPLES SUBMITTED BY CENTRE DE RECHERCHE INDUSTRIELLE DU QUEBEC

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CERAMIC SECTION
INDUSTRIAL MINERALS LABORATORY

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by

K. E. Bell

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INTRODUCTION

A request was received from Mr. François Dugal, Head, Ceramic Group, Materials Division, CRIQ, Ste. Foy, Québec, for Pyrometric Cone Equivalent (PCE) determinations on three samples of refractory materials under investigation at CRIQ. Because commercial facilities for reliable PCE testing are not known in Canada, it was agreed that the tests would be performed in the Ceramic Section of CANMET, on a cost-recovery basis.

Three samples of refractory brick marked MA1, MA2 and MA3 were provided, already ground to minus 65 mesh according to the requirements of ASTM Designation C24-72, Standard Method of Test for Pyrometric Cone Equivalent (PCE) of Refractory Materials. It was indicated that all three materials were expected to have PCE's in the range Cone 26 to Cone 30.

PROCEDURE

Test cones were prepared as provided in ASTM C24. Because the materials were non-plastic, a small amount (1 to 1.5%)

of polyvinyl alcohol was added in the tempering water as a binder. As the materials were pre-fired, it was not necessary to pre-calcine the cones.

The initial, high-temperature firing was performed in a gas-fired, pebble-bed PCE furnace. The rate of heating was that provided in Table 2 of ASTM C24 (above Cone 26) and Orton standard PCE cones from No. 23 to No. 31½ were used for comparison. A Cone No. 20 was included as a guide to enable precise regulation of the rate of heating. The test cones of materials MA1 and MA2 deformed at a temperature far below that equivalent to Cone 20, and estimated to be approximately Cone 12. To establish the PCE's of these samples, a second, low-temperature test was conducted.

Because the high-temperature PCE furnace is difficult to control at low temperatures and the precision of the results may be questionable, the low-temperature PCE test was performed in a gas-fired, down-draft furnace specially designed for the purpose and capable of close control to temperatures equivalent to Cone 16. Full size (2½ inch) test cones were used, with full-size Orton standard Pyrometric cones from No. 9 to No. 15 for comparison: a No. 8 cone was included for guide purposes. The rate of heating above Cone 8 was 150°C per hour, as provided in the standard PCE tables.

Because the second test did not precisely define the PCE of sample MA2, Mr. Dugal was consulted as to the need for further testing. It was agreed that none would be required.

RESULTS AND DISCUSSION

The PCE of sample MA1 was Cone 14^{+} ($1375^{\circ}C$). This is below the absolute minimum of Cone 15, specified by ASTM C27-70, Standard Classification of Fireclay and High-Alumina Refractory Brick.

At Cone 15, sample MA2 had just begun to deform and had reached approximately the 1 o'clock position. The PCE of this material is estimated to be Cone 16 (standard cone equivalent $1473^{\circ}C$). This is equal to only about Cone $15\frac{1}{2}$ in terms of PCE cones. There is risk that normal variations inherent in natural deposits could result in brick that fail to meet the minimum specification for refractories.

The PCE of sample MA3 was Cone 28^{+} ($1650^{\circ}C$). This is equivalent to most low-duty fireclay brick currently available commercially.

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